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**APPLICATION  
FOR  
UNITED STATES  
LETTERS PATENT**

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**FOR: STATISTIC MULTIPLEX  
TRANSMISSION SYSTEM**

**DOCKET NO.: WN-2155**

## STATISTIC MULTIPLEX TRANSMISSION SYSTEM

## BACKGROUND OF THE INVENTION

This invention relates to a statistic multiplex transmission system. More particularly, this invention relates to a multiplex gateway apparatus for executing statistic multiplex transmission of images in public ATM inter-network communication.

Means for executing ATM transmission of image signals, to which variable rate encoding is applied by an MPEG2 system using a terminal stipulated by ITU-T recommendation, H. 310 (hereinafter called merely the "terminal device") is known generally. In other words, when ATM transmission is performed, image transmission means is known that connects a local area ATM network laid down in a first area to a local area ATM network laid down in a second area through a public AM network, and transmits images.

An image ATM transmission according to the prior art will be explained with reference to Fig. 1.

In the example shown in Fig. 1, the image terminal device uses an H. 310 terminal stipulated in H. 310 of the ITU-T recommendation. It will be assumed hereby that a CPN local area network n is laid down in a first area and a CPN local area network p is laid down in a second area. The CPN local area network n and the CPN local area network p are connected to each other through a B-ISDN public network o. H. 310 terminals 31 to 33 are connected to the CPN local area network n as shown in Fig. 1. H. 310 terminals 34 to 36 are connected to the CPN local area

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network p. The H. 310 terminals 31 to 33 are connected to any of the H. 310 terminals through the local area ATM network - public ATM network - local area ATM network. For example, the H.310 terminals 31 to 33 are connected to any of the H. 310 terminals through the local area ATM network - public ATM network - local area ATM network, respectively, as shown in Fig. 1. In other words, each H. 310 terminal is ATM connected independently in the point-to-point connection through the local area ATM network - public ATM network - local area ATM network.

In image transmission according to the prior art described above, the image signal that is VBR-encoded at each H.310 terminal by an MPEG2 system is merely ATM connected independently. Therefore, a statistic multiplex effect cannot be imparted to the image signal outputted from each H. 310 terminal. In other words, the image transmission system using the H. 310 terminal according to the prior art involves the problem that the statistic multiplex effect cannot be acquired because each H. 310 terminal is connected independently in the point-to-point connection.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a statistic multiplex transmission system capable of obtaining a statistic multiplex effect in an image transmission system, for example, in an image transmission system using H. 310 terminals.

To perform multi-channel transmission of image signals, for example, the present invention interposes a statistic multiplex gateway to a connection portion between local area

ATM networks, to which each terminal device is connected, and a public ATM network, and performs statistic multiplex transmission of the images by public ATM inter-network communication. When ATM multiplex transmission of the image signals, to which variable rate encoding is applied by an MPEG2 system using terminal device stipulated by H. 310, the ITU-T recommendation, is performed, the present invention offers an efficient multi-channel image transmission service as it connects a local area ATM network laid down in a certain area to a local area ATM network laid down in another area through a public ATM network. Furthermore, re-negotiation of the transmission rate after statistic multiplexing is repeated in a predetermined time interval through adaptive control of parameters acquired from image information, and piece-wise constant bit rate transmission is performed to vary the transmission rate of the public ATM network to reduce further a required transmission rate.

In a network that includes a first local area ATM network to which a plurality of first terminal device are connected, a second local area ATM network to which a plurality of second terminal device are connected and a public ATM network connected to the first and second local area ATM networks, the present invention provides a statistic multiplex transmission system that comprises a first multiplex gateway apparatus for connecting the first local area ATM network and the public ATM network and a second multiplex gateway apparatus for connecting the second local area ATM network and the public ATM network, wherein the first and second multiplex gateway devices receive transmission ATM signals from the first and second local area

ATM networks, respectively, perform statistic multiplexing process of the transmission ATM signals to generate transmission statistic multiplex signals and transmit the transmission statistic multiplex signals to the public ATM network. Each of the first and second multiplex gateway devices includes means for calculating statistic information represented by a mean rate and a peak cell rate of ATM cells of the transmission ATM signals, means for conducting rate addition after statistic multiplexing according to the statistic information and determining the result of the rate addition, means for calculating a required piece-wise constant bit rate on the basis of the rate addition result and executing cell multiplex control on the basis of the piece-wise constant bit rate, and means for transmitting the transmission statistic multiplex signals according to this cell multiplex control.

### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an image transmission network according to the prior art.

Fig. 2 shows a network using a multiplex gateway device according to the present invention.

Fig. 3 is a block diagram showing in detail the terminal device shown in Fig. 2.

Fig. 4 shows in detail the multiplex gateway device shown in Fig. 2.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the present invention will be explained with reference to the accompanying drawings.

Referring to Fig. 2, it will be assumed hereby that a transmission ATM signal a is outputted from a terminal 1, a transmission ATM signal b is outputted from a terminal 2 and a transmission ATM signal c is outputted from a terminal 3. The transmission ATM signals a to c are applied to a statistic multiplex gateway 4 through a local area ATM network d (CPN local area network; Customer Premises Network). The statistic multiplex gateway 4 performs statistic multiplexing process of the transmission ATM signals a to c, and generates a transmission statistic multiplex signal e.

This transmission statistic multiplex signal e is transmitted to a B-ISDN public ATM network f (B-ISDN public network) by use of a piece-wise constant bit rate transmission system (piece-wise CBR) having the transmission rate after statistic multiplexing process which varies in a predetermined time interval. The statistic multiplex signal e is connected to a statistic multiplex gateway 5 disposed in a separate area. The statistic multiplex gateway 5 separates the ATM signals that are subjected to statistic multiplexing. In other words, a receiving ATM signal h, a receiving ATM signal i and a receiving ATM signal j are generated when the transmission statistic multiplex signal e is separated. These receiving ATM signals h, i and j are transmitted to terminals 6, 7 and 8, respectively, through a local area ATM network (CPN network) g.

Communication in an opposite direction is established similarly. The transmission ATM signals h, i and j are supplied as the receiving ATM signals a, b and c to the terminals 1, 2 and 3, respectively. Incidentally, in the embodiment shown in the drawing, three terminals are shown connected to the local

area ATM networks d and g, respectively, but the number of terminals connected to each local area ATM network is generally N (N: an integer of 2 or more). The terminals 1 to 3 and 6 to 8 are the terminals that are stipulated in H. 310 of the ITU-T recommendation.

The construction of the terminals will be explained with reference to Fig. 3. Though the explanation will be given on the terminal 1 in the embodiment shown in the drawing, other terminals have the same construction.

When an encoding process is performed, a video signal inputted from a camera 10 is supplied to an image signal encoding/decoding unit 14. The image signal encoding/decoding unit 14 performs high efficiency encoding by a variable bit rate (VBR) mode for the video signals, generates a transmission video stream and supplies the transmission video stream to a system multiplexing/demultiplexing unit 16.

Audio signals inputted from a microphone 12 are supplied to a speech signal encoding/decoding unit 15. The speech signal encoding/decoding unit 15 performs high efficiency encoding for the audio signals, generates a transmission audio stream and supplies the transmission audio stream to a system multiplexing/demultiplexing unit 16.

The system multiplexing/demultiplexing unit 16 performs a multiplex processing for the transmission video stream and the transmission audio stream and supplies a transmission system stream to an ATM transmission line unit 17. The ATM transmission line unit 17 converts the transmission system stream to ATM cells to generate a transmission ATM signal a, and transmits the transmission ATM signal a to a local area ATM network d.

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During the decoding processing, the ATM transmission line unit 17 performs an ATM terminating processing for the receiving ATM signal a inputted from the local ATM network d and supplies the receiving system stream to the system multiplexing/demultiplexing unit 16. The system multiplexing/demultiplexing unit 16 separates the receiving system stream into the receiving video stream and the receiving audio stream, and supplies them to the image signal encoding/decoding unit 14 and to the speech signal encoding/decoding unit 15, respectively.

The image signal encoding/decoding unit 14 performs the decoding processing of the receiving video stream and outputs the video signals to a monitor 11. On the other hand, the speech signal encoding/decoding unit 15 performs the decoding processing of the receiving audio stream, and supplies the audio signals to a speaker 13.

Next, the construction of the statistic multiplex gateway will be explained with reference to Fig. 4. The statistic multiplex gateway 4 in the embodiment shown in the drawing will be explained hereby, but other statistic multiplex gateways have the same construction.

The transmission ATM signals a to c outputted from the terminals 1 to 3 in the manner described above are supplied to ATM transmission line units 21 to 23, respectively. Each of these ATM transmission line units 21 to 23 calculates statistic information represented by the mean rate and the peak cell rate of the inputted ATM cells, and outputs the statistic information and the ATM cells to an ATM cell multiplexing/demultiplexing unit 26.



The ATM cell multiplexing/demultiplexing unit 26 applies the statistic information to a statistic multiplexing control unit 24. The statistic multiplexing control unit 24 performs rate addition after statistic multiplexing according to the statistic information, and applies this rate addition result to a piece-wise constant bit rate control unit 25. The piece-wise constant bit rate control unit 25 calculates a required piece-wise constant bit rate on the basis of the rate addition result. The ATM cell multiplexing/demultiplexing unit 26 performs cell multiplexing control on the basis of the piece-wise constant bit rate. In consequence, the ATM cell multiplexing/demultiplexing unit 26 performs the multiplexing process of the AM cells and transmits the transmission statistic multiplex signal e to a B-ISDN public ATM network.

As described above, the present invention connects a plurality of image transmission terminals connected to the same CPN (Customer Premises Network) local area network to the terminals of the CPN local area network laid down in another area through the B-ISDN public network. Since the present invention performs statistic multiplexing in this connection, the present invention can acquire both statistic multiplexing gain and re-negotiation gain in comparison with the case where image channels are discretely connected one by one between individual terminals.